Spellenberg, R., T.R. Van Devender, and P.D. Jenkins. 2014. *Astragalus martinii* (Fabaceae), a new species from eastern Sonora and western Chihuahua, Mexico. Phytoneuron 2014-66: 1–8. Published 1 July 2014. ISSN 2153 733X

ASTRAGALUS MARTINII (FABACEAE), A NEW SPECIES FROM EASTERN SONORA AND WESTERN CHIHUAHUA, MEXICO

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ABSTRACT

A new species, **Astragalus martinii** Spellenb., Van Devender, & Jenkins, is described from the Mesa del Campanero in extreme eastern Sonora and the Sierra Obscura of Chihuahua, Mexico. The free stipules of *A. martinii*, basally fixed pubescence, and fully bilocular ascending pods place the new species with the sect. *Leptocarpi* as delimited by Barneby in 1964. Within that section it uncomfortably settles near subsect. *Parvi*, differing in habit and particularly proportions of the pod. A key is provided to distinguish *A. martinii* from other species of sect. *Leptocarpi* in the mountains of eastern Sonora, and other species in the vicinity of Yécora, Sonora, are mentioned. The name of this new species honors Paul S. Martin, geoscientist at the University of Arizona and a plant explorer of the northern Sierra Madre Occidental.

In the mid-1930s, Howard Scott Gentry explored remote areas in southern Sonora, making extensive plant collections, noting the vegetation and taking photographs, these efforts resulting in his landmark publication about of the vegetation of the region (Gentry 1942). Although his Río Mayo Region extended north to the Yécora area in the Río Yaqui drainage, he only visited Santa Ana in tropical deciduous forest in that area. He barely entered the Sierra Obscura (Gentry used "Sierra Obscura in his 1942 book and on his collection labels; an alternate spelling is "Oscura").

In the spring of 1985 Paul Martin collected an *Astragalus* from the remote Sierra Obscura in west-central Chihuahua, a specimen that was initially identified as *A. gentry* Standl. This appears to be the first collection of the species described herein. Since that time, the completion of Mexico Federal Highway 16 (MEX 16) between Hermosillo, Sonora, and Cd. Chihuahua, Chihuahua, in 1992 provided greater access to the Sierra Madre Occidental. Between 1975 and 1994, numerous plant collections were made in western Chihuahua and eastern Sonora, including the Yécora area, by Raymond M. Turner, Paul S. Martin, and their students and associates, especially Ana L. Reina-Guererro, Mark Fishbein, George M. Ferguson, and Richard S. Felger. These collections were included in a thorough revision of Gentry's 1942 publication (Martin et al. 1998).

In 1995, Ana L. Reina-G. and Tom Van Devender began an intensive survey of the flora of the Municipio de Yécora in eastern Sonora. The Yécora flora, now known to have at least 1773 taxa, is very diverse, reflecting the Madrean Tropical floristic subdivision of the Sierra Madre Occidental (González-E. et al. 2012; Van Devender & Reina-G. 2014). Endemism is high, with 13 species known only from this Municipio (Van Devender & Reina-G. 2014). Shortly thereafter, *Astragalus*

specimens from the Mesa del Campanero were sent to Rupert Barneby at the New York Botanical Garden. Barneby recognized this *Astragalus* as an undescribed species and communicated that to Van Devender. We here describe the new species; specimens will be distributed as cited.

ASTRAGALUS MARTINII R. Spellenberg, T.R. Van Devender, P.D. Jenkins, **sp. nov.** Figures 1–3. **TYPE: MEXICO. Sonora.** Mpio. de Yécora, 1 km W of Puerto de la Cruz on MEX 16, N slope of Mesa del Campanero, 28° 22' 34" N, 109° 02' 13" W, 1840 m elev., common herbaceous perennial on rocky slope, growing with *Astragalus gentryi*, flowers lavender, 30 Mar 1997, *A.L. Reina-G. 97-458* with T.R. Van Devender (holotype: ARIZ; isotypes: MEXU, MO, NMC, NY, US, USON).

Slender, moderately leafy perennial, thinly strigulose with fine, straight, appressed, white or blackish (or mixed) hairs 0.2–0.3 mm long, the herbage green the leaflets glabrous on adaxial surface. ***Stems*** slender, 1–3 dm long, few to many, radiating from the crown of a slender taproot, branched near the crown, otherwise mostly simple, very thinly strigulose, floriferous from below the middle, decumbent spreading, ascending or erect, sometimes shallowly buried for up to 1 dm (then specimens appearing more or less rhizomatous). ***Stipules*** narrowly triangular to ovate, semi-amplexical, membranous, pale green, 2–3.5 mm long, sparsely strigose on adaxial surface, the margins often more or less ciliate. ***Leaves*** (1.5–)3–10 cm long, with slender petioles ca. 1/5–1/4 the length of the blade; blade of larger leaves with 15–23 obovate or oval to narrowly obovate, elliptic, or oblong, truncate-emarginate or rounded, flat, thin-textured leaflets 2–10 mm long, glabrous on adaxial surface, strigulose abaxially. ***Peduncles*** slender, erect or ascending, straight or a little incurved, 2–10 cm long. ***Racemes*** densely to moderately loosely (1–)6–11-flowered, the flowers spreading to widely ascending, the axis 3–15 mm long in flower, about the same in fruit, the short racemes of flowers and fruits often appearing subcapitate. ***Bracts*** membraneous, pale stramineous to pale purplish, lanceolate to triangular, 1.3–2.3 mm long. ***Pedicels*** ascending or arched outward, at anthesis 0.5–1.8 mm long, about the same in fruit. ***Bracteoles*** usually 0, when present 1–2, pallid, linear-lanceolate, 0.5–1.5 mm long. ***Calyx*** 4.5–6.1 mm long, moderately to densely strigulose with black, white, or mixed black and white hairs, the oblique disk 0.8–1.1 mm deep, the membranous greenish or purplish, deeply campanulate or subcylindric tube 2.5–4 mm long, 1.6–2.3 mm in diameter, the linear-lanceolate to narrowly triangular, subherbaceous teeth 1.6–2.3 mm long, the whole becoming papery-membraneous, ruptured, persistent around base of pod. ***Flowers*** 7.5–10 mm long. ***Petals*** purple at tips, whitish or pale lilac basally. ***Banner*** recurved through 60–90°, claw 3.8–4.2 mm long, blade broadly ovate, 6.1–7 mm long, 5–5.5 mm wide, rounded across the apex except for a shallow notch at tip. ***Wings*** claw 3.5–4.9 mm long, blade obliquely ovoid, 5.0–5.6 mm long, 1.6–2.5 mm wide, gently incurved through 25–30°, margin entire, tip rounded. ***Keel*** (0.8–1 mm shorter than wings) 6.5–8.2 mm long, claws 3.4–4 mm long, blade 3.4–4.2 mm long, 1.9 mm wide, the half ovate blades incurved through 90° to the obtuse, widely acute tip. ***Anthers*** 0.3–0.4 mm long. ***Ovules*** 19–26. ***Pods*** sessile, semi-persistent, in dense clusters as wide or wider than long at the tips of the peduncles, often humistrate; pod as viewed from ventral surface broadly lance-ovoid in outline, as viewed from the side slightly incurved to incurved through about 1/5 of a circle, 9–12 mm long, 4.5–6.5 mm wide, about twice as broad as deep, rounded at base, distally contracted into a short, triangular-cuspidate apex, broadly and bluntly triquetrous, obtusely low-carinate by the thick ventral suture, the lateral faces deeply convex, the dorsal face moderately open-sulcate, the finely strigulose subcoriacous valves green, becoming stramineous, and later blackish, when dry finely transverse rugulose, inflexed as a complete septum about 1.1 mm wide; dehiscence tardy, perhaps occurring on the ground, beginning at the apex. ***Seeds*** brown, dull or slightly lustrous, slightly wrinkled. 1.3–1.7 mm long.

All of the collections of *Astragalus martinii* are from pine-oak forest. At the type locality west of Puerto de la Cruz on the northern slopes of Mesa del Campanero, at 1840 meters elevation, the pine-oak forest on steep rocky slopes is very diverse, dominated by *Pinus engelmanni* and

Quercus arizonica. Most of the paratypes are from flatter areas at 1900 to 2195 meters on top of Mesa del Campanero. In this area, pine-oak forest includes *P. strobiformis* and *Q. jonesii*. Beginning in the 1950s, large areas of pine-oak forest were cleared for apple and other fruit orchards (Rubén Coronado, pers. comm., 2007). *Astragalus martinii* mostly occurs in clayey soil on relatively flat rocky surfaces formed by weathered Oligocene basalt but also was found on disturbed roadsides and in a plowed cornfield near the village of Campanero. It was also found on rocky slopes in mesic pine-oak forest with *Abies durangensis* in Barranca El Salto on the western edge of Mesa del Campanero. In general, *Astragalus martinii* is known to occur between 1800 and 2200 meters elevation.

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Figure 1. Holotype of *Astragalus martinii* (*Reina-G. 97-458* et al., ARIZ).

Figure 2. Comparatively large, open form of *Astragalus martini* (*Reina-G. 99-703* et al., ARIZ).

Figure 3. Comparatively small, tufted form of *Astragalus martini* (*Van Devender 95-342* and Reina-G., NMC).

Figure 4. Map of northwestern Mexico and southwestern United States, dots indicating known distribution of *A. martini*. More northerly dot represents Mesa del Campanero, the more southerly dot the Sierra Obscura.

Astragalus martinii has two morphological extremes on Mesa del Campanero. Some plants are green, and large, with slightly larger pods and flowers in comparison to the other extreme, which consists of plants that are comparatively low, densely tufted, and grayish with denser pubescence, the flowers and pods averaging smaller. These phases may be ecologically induced, the smaller, more tufted phase recorded as being in the open, along roads, or in flat ponderosa pine forest. The type is more or less in the middle of the range of variation, being fairly large, green, and leafy, while at the same time fairly densely tufted. In the specimens citations we have noted which form the particular collection represents if it seems extreme by indicating "large, open" and "small, tufted."

Additional specimens examined. **Chihuahua. [Mpio. de Moris]**, Sierra Obscura, under pines, 2000 m, 28° 00' 40" N, 109° 01' 00" W, 26 Mar 1985, *Martin s.n.* (ARIZ). **Sonora. Mpio. de Yécora**: Between El Llano and Campanero, Mesa del Campanero, W of Yécora, 28° 20' 15" N, 109° 01' 15" W, 2100 m, 10 Mar. 1996, *Reina-G. 96-32* (ARIZ, MEXU) (small, tufted); N end of Mesa del Campanero; pine-oak forest, 28° 21' 33" N, 109° 01' 42" W, 2140 m, common herbaceous perennial in shady understory, flowers lavender, some very light, 18 Sep 1999, *Reina-G. 99-703* (ARIZ, MEXU) (large, ± open); ca. 6 air km WSW of Yécora on N end of Mesa del Campanero, 28° 22.17' N, 109° 01.82" W, 2195 m, igneous rock and soil in pine, juniper, and oak woods, 16 Aug 1998, *Spellenberg, Brouillet, & Todsen 12644* (MEXU, NMC, NY); Mesa del Campanero, 1 km N of El Llano along road to MEX 16, 28° 20' 44" N, 109° 01' 42" W, ca. 2100 m, open area on a level mesa in pine-oak woodland, 26 May 1996, *Steinmann 868* (ARIZ, NMC) (small, tufted); Mesa del Campanero, W of Yécora, 28° 21' 30" N, 109° 01' 45" W, 2120 m, pine-oak forest, 1 May 1995, *Van Devender 95-342* (ARIZ, ASU, NMC, RSA, TEX) (small, tufted); Mesa el Campanero, pine-oak forest, 28° 21' 36" N, 109° 01' 36" W; 2100 m, canyon bottom, 6 Sep 1996, *Van Devender 96-384* (NMC, UC, USON) (large, ± open); Mesa el Campanero, pine-oak forest, 28° 21' 36" N, 109° 01' 36" W, 2100 m, roadside, 6 Sep 1996, *Van Devender 96-38* (ARIZ, CIIDIR, RSA) (large, ± open); Mesa del Campanero, Arroyo Largo at head of Barranca El Salto, pine-oak forest, 28° 20' 44" N, 109° 01' 30" W, 2000 m, arroyo bottom, 6 Sept 1996, *Van Devender 96-427* (ARIZ, NMC); El Llano, Mesa del Campanero, 10 km (by air) WSW of Yécora, 28° 20' 28" N, 109° 01' 54" W, 2100 m, open heavily grazed area, 14 Mar 2000, *Van Devender 2000-149* (NMC) (small, tufted); N end of Mesa del Campanero, pine-oak forest, 28° 21' 33" N, 109° 01' 42" W, 2140 m, 5 Apr 2000, *Van Devender 2000-214* (ARIZ) (small, tufted); Barranca El Salto, Mesa del Campanero; pine-oak forest, 28° 21' 18" N, 109° 01' 28" W, 1900 m, locally common perennial herb on rocky slope, flowers light purple (most not yet in flower), 23 Jul 2005, *Van Devender 2005-1139* (NMC); Omar Fraijo's cornfield near Campanero on Mesa del Campanero (W of Yécora), pine-oak forest, 28° 20' 39" N, 109° 01' 22" W, 2115 m, common perennial herb in understory and tree wells in orchard, flowers lavender-pink, 26 Jun 2007, *Van Devender 2007-638* (MO, NMC); Barranca El Salto, Mesa del Campanero; pine-oak forest; 28° 21' 18" N, 109° 01' 48" W, 1900 m, locally very common perennial herb on rocky slope; flowers pink (most plants not reproductive), 7 Oct 2007, *Van Devender* 2007-1020 (ARIZ, ASU, DES, MEXU, MO, NMC, NY, TEX, USON, US) (large, ± open); Mesa del Campanero, upper tributary of Barranca El Salto, 28° 21' 18" N, 109° 01' 48" W, 2000 m, pine-oak forest, 9 Sep 1995, *Wiens 95-017* (ARIZ, NY); Mesa el Campanero, Arroyo largo, upper tributary of Barranca El Salto; 28° 21 ½' N, 109° 02' W, 2080 m, arroyo bottom in pine-oak forest with *Juniperus, Arbutus xalapensis, Quercus durifolia, Astranthium, Cologania, Ranunculus hydrocharoides, Prunella, Cheilanthes hirsuta*, 9 Sep 1995, *Wiens et al. s.n.* (ARIZ).

The late Paul S. Martin (1928-2010) was a geoscientist at the University of Arizona. Among other endeavors, he was known for his hypothesis of human-induced Pleistocene extinction of large mammals in North America. Paul was also deeply interested in the flora and its composition in the northern Sierra Madre Occidental. Therefore, we name this *Astragalus* in recognition of his pioneering contributions to our knowledge of the biota of this region. Though stricken with polio as a young man and walking with one or two canes he, nevertheless, continued field work in remote regions throughout his career. Each of us authors and numerous other individuals have fond memories of one or more field trips led by him. In March 1975, he led an expedition from the University of Arizona to cross the Sierra Madre Occidental through Yécora to the Cascada de Basaseáchi in Chihuahua long before the completion of Mexico Hwy 16 in 1992. He inspired Deborah E. Goldberg to do her dissertation on the vegetation and flora of hydrothermally altered soils on gossans near Santa Ana in 1975-1977 and 1980 (Goldberg 1982). He visited Mesa del Campanero with George M. Ferguson in 1988, 1990, and 1992. He introduced Yécora to Mark Fishbein. Botanical collections made by him and associates were incorporated into the 1998 Gentry's Río Mayo Flora book (Martin et al. 1998).

For North American *Astragalus*, Barneby (1964) constructed a classification with informal phalanxes, wherein he associated species further in formal sections and subsections. Most, if not all, his subsections were new and were described around those species included within. *Astragalus martinii* easily keys to the sect. *Leptocarpi*, but there its identification stalls, its comparatively broad, tardily dehiscent pod preventing easy association with the subsections Barneby constructed. The nature and timing of dehiscence of the pod still is not known but probably occurs on the ground. Pods may be retained on the usually humistrate raceme until well blackened, but on some specimens they may be dislodged fairly easily. If they are ultimately deciduous and dehisce once detached, this precludes the inclusion of *A. martinii* into sect. *Coahuilani*, which has truly persistent pods that dehisce on the raceme. With its relative deep calyx tube, *A. martinii* resembles species in sect. *Pringleani*, where the short, broad pod differs from the usually linear, narrow pods of four species in that section. The pod is more characteristic of sect. *Parvi*. At this time we do not include *A. martinii* in any subsections as constructed by Barneby, but we do believe it belongs within sect. *Leptocarpi*.

The following key distinguishes *Astragalus martinii* from other members of the section *Leptocarpi* that are known to occur above the desert in eastern Sonora (adapted from Barneby 1964).

1. Plants annual, germinating either in fall, winter, or spring, but truly monocarpic, perishing after fruiting ..... **Astragalus nuttallianus** (Nutt.) A. DC.
1. Plants perennial, sometimes short-lived, or biennial, often flowering the first season but not truly monocarpic (nearly always some aged plants in population).

2. Pubescence dolabriform ..... **Astragalus arizonicus** A. Gray
2. Pubescence basifixed.

3. Pods relatively broad, 1/3–½ as broad as long; keel broadly acute or bluntly deltoid.

4. Inflorescences densely compact, 1–1.5 cm long, about as wide, appearing shaggy-hairy because of the densely strigulose-villous calyces; pods shaggy strigulose-villose, stramineous when fully mature ..... **Astragalus hypoxylus** S. Wats.
4. Inflorescence compact, sometimes loosely so, 1.5–3 cm long, often longer than wide, not appearing shaggy-hairy; pods minutely strigulose, black when full mature ..... **Astragalus martinii** Spellenb., Van Devender, & Jenkins

3. Pod relatively narrow, 1/5 as wide as long or narrower; keel tip triangular-acute to subulate and forming an erect to strongly porrect beak.

5. Petals irregularly graduated, the triangular-acute keel-tip surpassing the wings by 0.2–0.8 mm, the shallowly lobed wing-blades relatively short (4–5 mm long) and broad ..... **Astragalus gentryi** Standl.
5. Petals regularly graduated, the keel shorter than the wings and with an erect or porrect beak ..... **Astragalus nothoxys** A. Gray

***Astragali* of Yécora**

Small *Astragalus* were collected all along MEX 16 in the Municipio de Yécora. *Astragalus gentryi* is widespread from 650 meters elevation in tropical deciduous forest to 1860 meters in pine-oak forest but mostly occurs below *A. martinii*. *Astragalus hypoxylus* was found in oak woodland and pine-oak forest at 1500 to 1840 meters elevation south of Maycoba, in Yécora, and just west of Puerto de la Cruz, the latter locality very close to the type locality of *A. martinii*. These records for *A. hypoxylus* in the Sierra Madre Occidental are interesting because it was thought to be a rare endemic in Cochise and Santa Cruz counties, Arizona, 370 km to the north-northwest (Barneby 1964) and is a Species of Concern for the U.S. Fish and Wildlife Service. *Astragalus nothoxys* was found at 1460 to

1540 meters at Maycoba, Yécora, and La Palmita, mostly in oak woodland. Thus, four species of tufted *Astragalus* and the larger white-flowered *A. longissimus* (sect. *Strigulosi*) occur in montane woodlands and forests in the Yécora area. The annual *A. nuttallianus* var. *austrinus* was found at 490 meters elevation in foothills thornscrub at Curea.

ACKNOWLEDGEMENTS

When the description of a new species has taken 2.5 decades to appear from an area once remote but now with increasing botanical exploration because of easier access, some explanation seems in order. During that time key players have changed employment or retired, the major herbarium involved with the species was moved, and series of unmounted, unlabelled specimens were squirreled away, seemingly undiscoverable even by those working with the taxon. We sincerely thank the good work of Sarah Hunkins, Shelly McMahon, Ben Brandt, and George Ferguson, all of ARIZ, for finding much of the "lost" material cited in this paper and helping us with distribution of specimens. We appreciate Rupert Barneby's early comments, where he believed that Van Devender and his colleagues had, indeed, discovered a new species of *Astragalus*. Ana L. Reina-Guerrero, wife of Tom Van Devender, introduced him to Yécora in 1994, beginning a dozen years of rewarding plant exploration and discovery.

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